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A FULLY IMPLICIT DOMAIN DECOMPOSITION ALGORITHM FOR DISCRETE-VELOCITY BGK EQUATION

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Abstract. Popular approaches for solving discrete-velocity BGK equation are explicit and semiimplicit methods, and both have certain constraints on the time step size. In this work, a fully implicit finite difference scheme is developed for the discrete-velocity BGK equation. We focus on a parallel, fully coupled, Newton-Krylov-RAS algorithm which imposes no limit on the time step size but requires the solution of a large sparse nonlinear system of equations at every time step. Here, RAS is a restricted additive Schwarz method. We show numerically that with such a preconditioned, nonlinearly implicit method the time step size is no longer constrained by the CFL condition, and scalable in terms of both strong and weak scalabilities on a supercomputer with thousands of processors.

Key words. Discrete-velocity BGK equation, fully implicit method, domain decomposition, Newton-Krylov-Schwarz, parallel scalability.

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